Level Two Landcover Classification Review

Classification Edits

Prepared for:

Office of Geographic Information, Commonwealth of Kentucky

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Classification Edits

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1 Overview

The level two landcover classification was created for the area of Zone 47, including the state of Kentucky, and parts of Ohio, Indiana and Tennessee. The landcover classification was submitted for review by a group of geomatics professionals. Space Imaging analysts reviewed comments and suggestions and changes were made to the landcover classification to produce a more accurate product.

Reviewer

2 Reviewers

REVIEWER	TITLE	AFFILIATION
Roy Boggs	Geoprocessor III	KY Div. Of Forestry
Julian Campbell	Conservation Scientist	The Nature Conservancy
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Keith Wethington	Biologist	KY Fish & Wildlife
Demetrio Zourarakis	Geoprocessor III	KY Div. Of Conservation

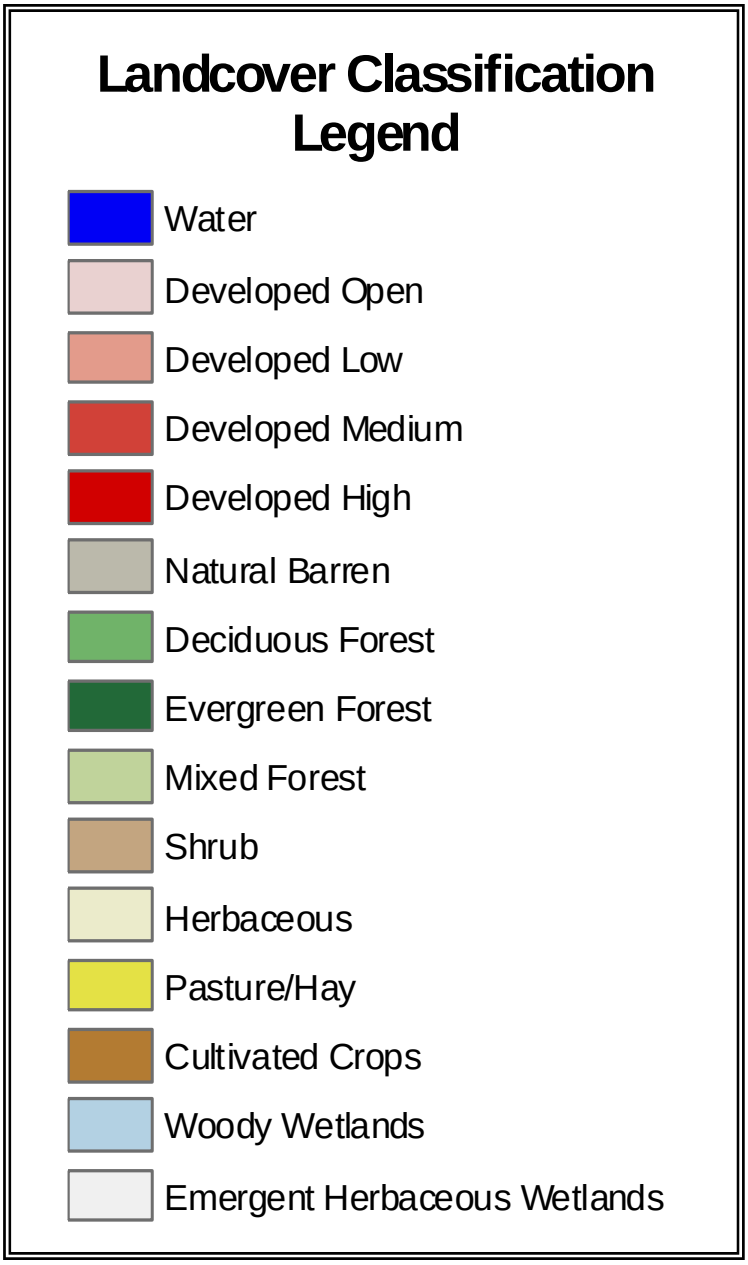
3 Summary of Review Team

The following table shows the summary of all the comments received by Space Imaging, and the issues that were derived from the comments.

Classification Issue	**Extent**
Agriculture, herbaceous and pasture/hay, in urban areas. Needs to be reclassified to Open Urban.	Systematic
Rivers that have been classified as emergent herbaceous.	Localized Example: 39’18”52N, 87’11”12W
Clouds in imagery.	Localized Example: 1014172, 1681749
Beaches or shoreline labeled as cropland.	Systematic
Impervious areas labeled incorrectly as barren.	Localized
Barren areas labeled as impervious.	Localized
Impervious areas misclassed as agriculture classes.	Localized
Water classes in impervious areas.	Localized
Abundance of mixed forest. Evergreen forests underrepresented.	Systematic
Abundance of pasture/hay.	Systematic, primarily in the eastern part of the zone.
Scattered cropland pixels	Systematic
List of localized errors that need to be fixed, identified by reviewers.	Localized

Table 1. Summary of review comments.

4 Legend

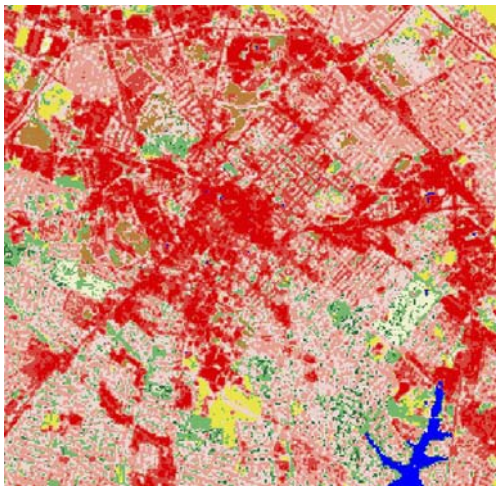

Landcover Classification Legend
Water
Developed Open
Developed Low
Developed Medium
Developed High
Natural Barren
Deciduous Forest
Evergreen Forest
Mixed Forest
Shrub
Herbaceous
Pasture/Hay
Cultivated Crops
Woody Wetlands
Emergent Herbaceous Wetlands

5 Solutions

Each problem was reviewed by a team of remote sensing analysts and a solution was created to correct each issue. Examples of each of the problems and their solutions will be discussed.

5.1 Agriculture, Herbaceous and Pasture/Hay in Urban Areas

This issue existed in any urban area within the mapping zone. Areas of Open Urban were often confused with agricultural classes. The solution to this issue was to create an Area of Interest (AOI) layer within each of the city boundaries, and then recode any misclassified class to the appropriate open urban class. The following images show these changes.



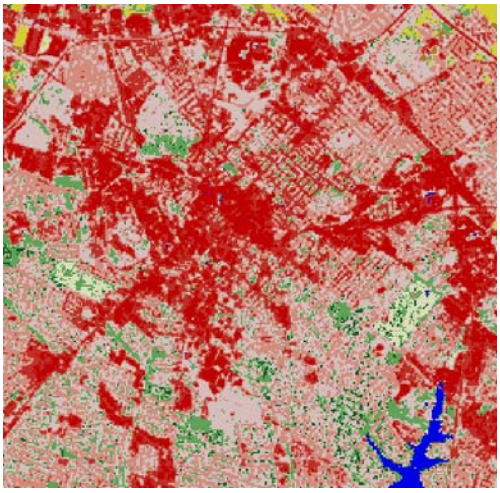


Figure 1: Cropland and Pasture/Hay in urban areas.
Figure 2: Cropland and Pasture/Hay recoded to Open Urban Class.

5.2 Rivers Classified as Herbaceous

One river in the imagery was found to be classified as herbaceous (Class 71) and not as water. In the NLCD92 classification, this river was correctly classified, and it's path had not been altered. An AOI was used to insert the NLCD92 water class for this particular area only. It was important that only this area be changed with the NLCD92 data, as the extent of some bodies of water in the imagery had changed between the 1992 and 2001 dates.

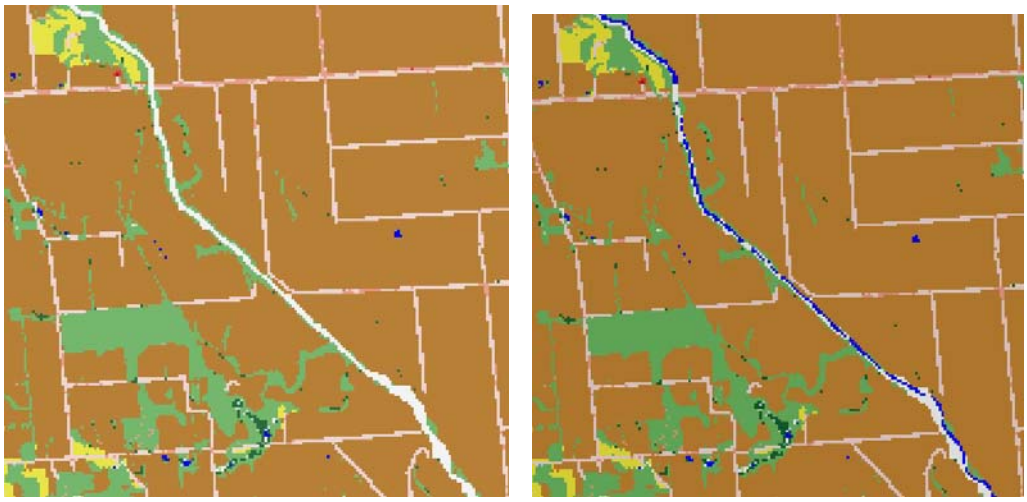


Figure 3: River classified as herbaceous.
Figure 4: River properly classified with NLCD92 data.

5.3 Clouds in Imagery

Clouds present in the imagery often led to a classification of cropland or water, even though the landcover did not suggest this. To correct this problem, the Landsat imagery was reviewed manually and reclassed in any area that was affected by cloud cover. The images below clearly show the corrections.

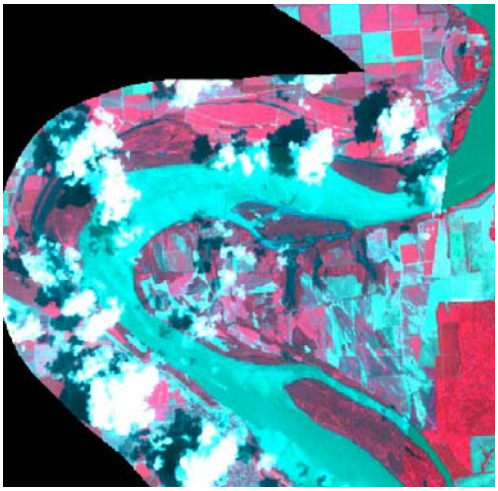


Figure 5: Landsat imagery of clouds in image.

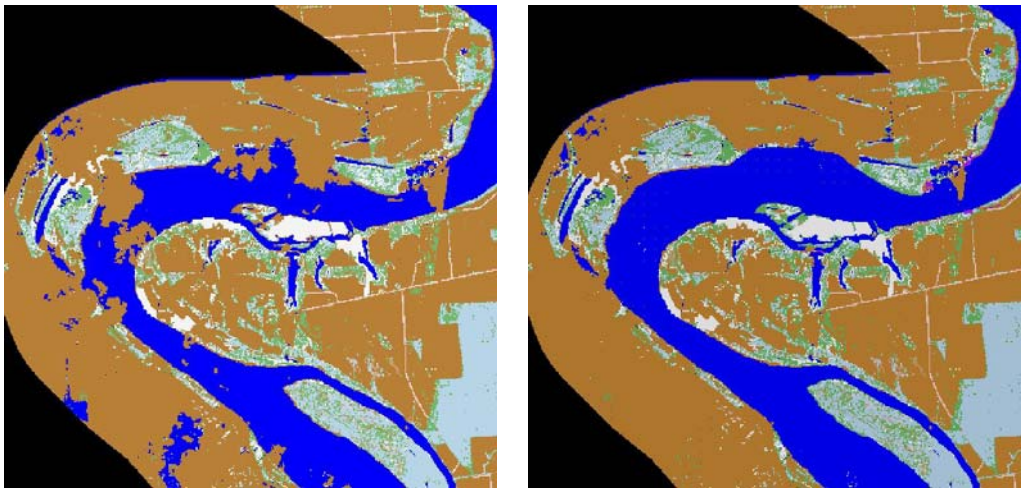


Figure 6: Clouds affecting classification with cropland in waterway and water classes created by cloud shadow.

Figure 7: Cropland classes removed from waterway, and water classes removed from agricultural area.

5.4 Beaches or Shoreline as Cropland

Throughout the entire imagery, it was found that cropland tended to incorrectly line the edges of large lakes. Inspection of the Landsat imagery showed that these cropland pixels were generally a barren class. This problem tended to occur around large bodies of water, so a clumping routine that would discard small water bodies was performed on the classification. Any body of water greater then 5000 pixels was then given a buffer. The buffer size was chosen to be 5 pixels, a conservative value. This value minimized the amount of true cropland in the analysis. A Normalized Difference Vegetation Index (NDVI) difference was created from the leaf-off and leaf-on Landsat imagery. This information was combined with an unsupervised classification of only the buffered areas of the lakes. Where the NDVI difference and the unsupervised classification met the appropriate thresholds, the cropland was recoded to a barren class. Final edits around the large lakes were completed by manual editing and inspection of the Landsat and other supporting imagery.

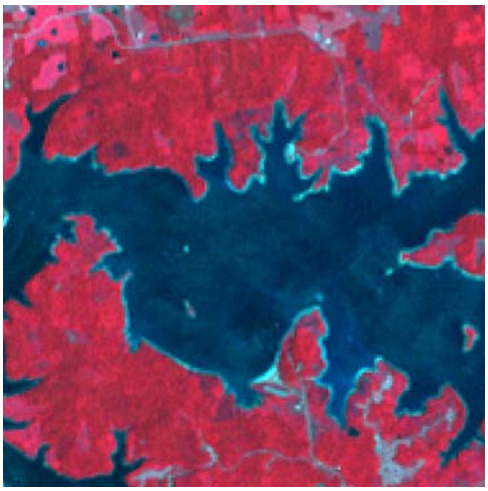
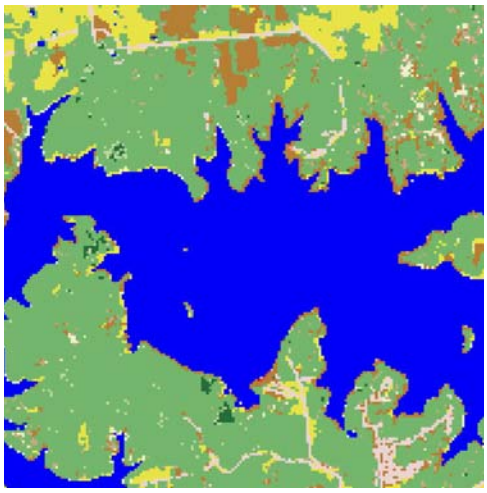


Figure 8: Imagery showing shoreline of large lake.



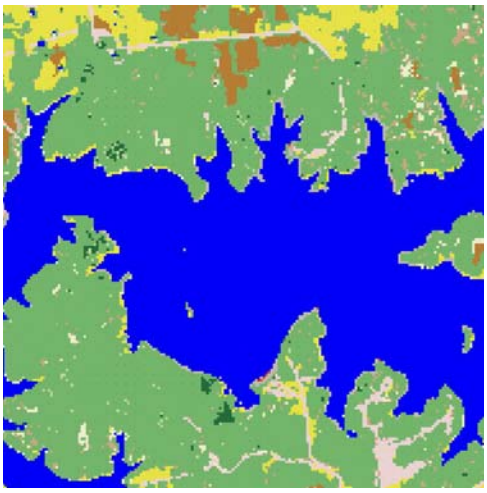


Figure 9: Original classification of cropland lining edges of large lakes.
Figure 10: Edited classification in which cropland is labeled as an appropriate class.

5.5 Impervious Areas Labeled as Barren

Often there is much confusion between impervious and barren classes, due to the similarity of the spectral signatures. Some impervious areas within city limits were labeled as barren. This problem was assessed by using supporting imagery and reviewing each urban area for barren inclusion areas.

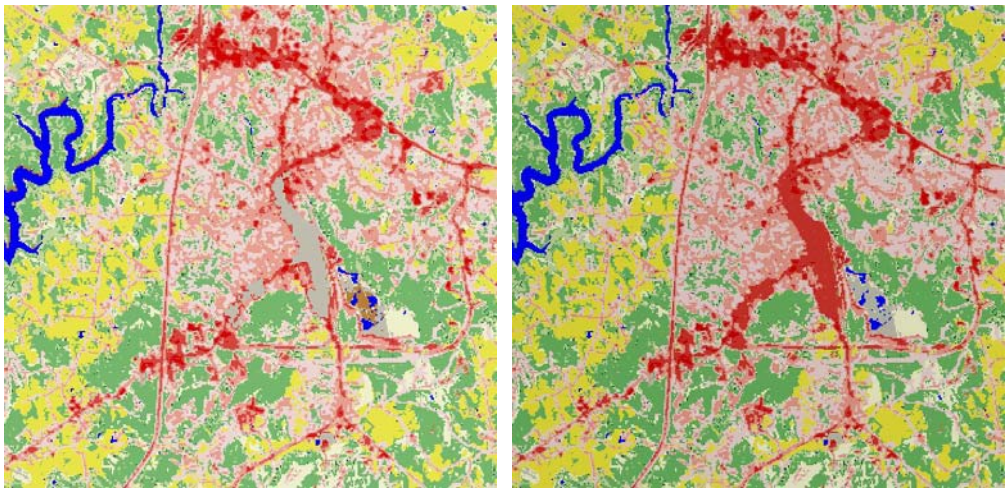


Figure 11: Impervious areas incorrectly labeled as barren.
Figure 12: Corrected classification, with impervious areas labeled as impervious.

5.6 Barren Areas Labeled as Impervious

Similar to the above problem, it was found that there were true barren classes labeled as impervious, mostly occurring outside of the city limits. This was addressed by using supporting imagery and NLCD92 data to determine where barren areas existed and to classify them correctly.

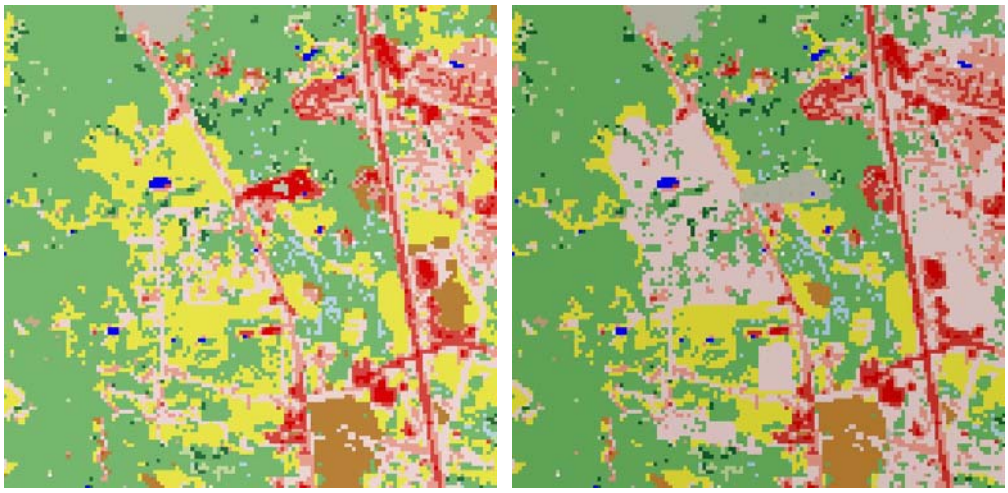


Figure 13: Barren area labeled as impervious.
Figure 14: Same area reclassed to barren class.

5.7 Impervious Areas Misclassed as Agriculture Classes

Due to the similarity of spectral response of some agriculture fields to impervious classes, some areas were improperly labeled. These were limited to specific

areas. The problem was corrected by using manual editing methods and supporting imagery to reclassify incorrect areas.

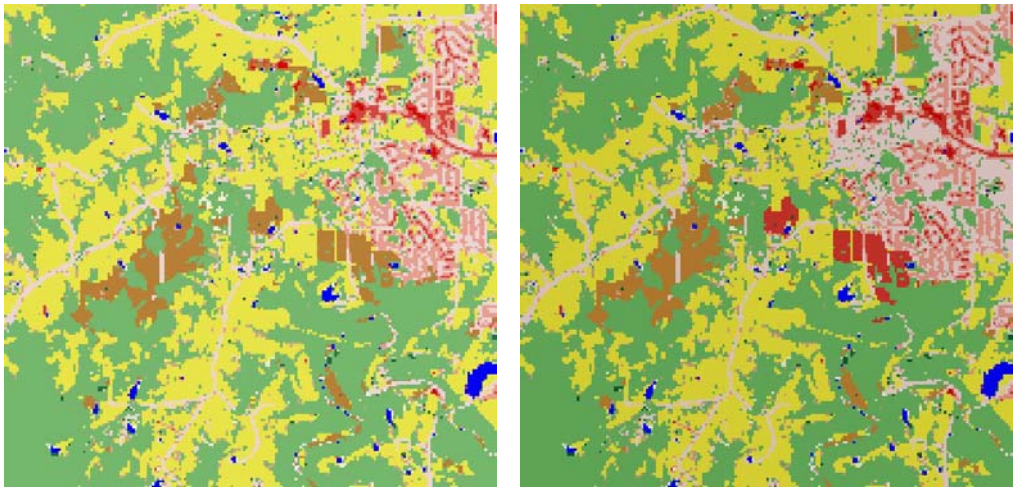


Figure 15: Impervious area incorrectly classified as cropland.
Figure 16: Impervious area corrected, and classified as impervious.

5.8 Water Classes in Impervious Areas

In one localized area, impervious structures were incorrectly labeled as water. This was easily corrected, because of the localized nature of this issue. Using supporting imagery, these water classes were recoded to the appropriate impervious class.

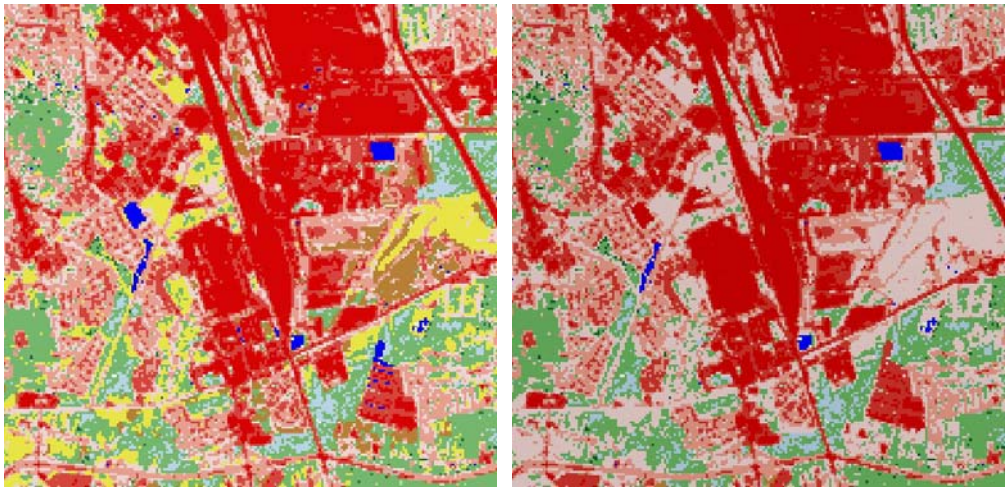


Figure 17: Water classes being incorrectly shown in impervious area.
Figure 18: Water classes recoded to correct impervious classes.

5.9 Abundance of Mixed Forest

Some reviewers found that there was an overabundance of the mixed forest class, and an exclusion of coniferous forest class. To correct this problem, Space Imaging analysts performed an unsupervised classification on a tasseled cap transformation of the Landsat imagery. Only those pixels previously classified as mixed or evergreen forest were analyzed. Statistics of the original landcover classification were then compared to the statistics in the unsupervised classification. The mixed class was recoded to an evergreen class if the spectral signature indicated it was predominantly evergreen. The use of supporting imagery (IKONOS and DOQ) was imperative in this process to ensure that mixed forests were being replaced with evergreen forests in the appropriate areas.

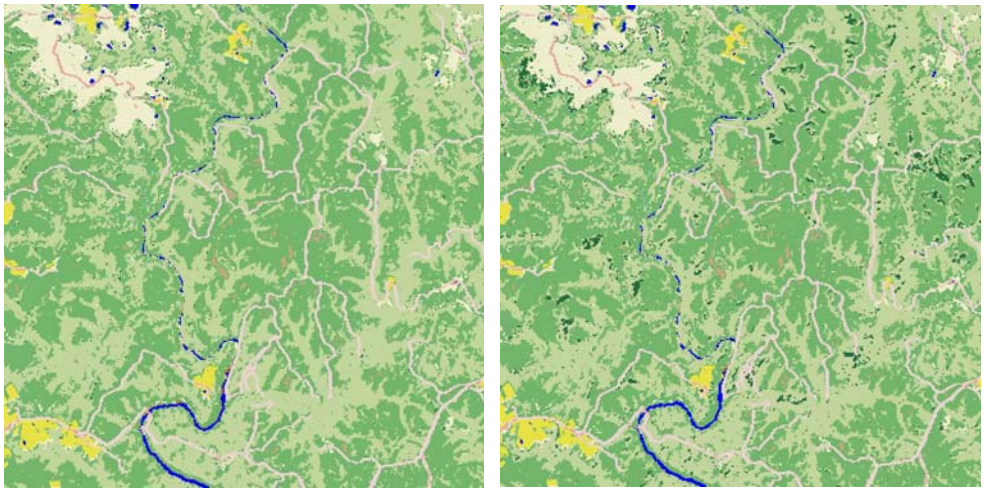


Figure 19: Abundance of mixed forest class, improperly labeled.
Figure 20: Evergreen classes introduced into the classification.

5.10 Abundance of Pasture/Hay

The spectral difference between the pasture/hay and herbaceous classes are very minimal. Because of this, the overabundance of pasture hay led to the exclusion of the herbaceous class. To rectify this situation, Space Imaging analysts used a rectangular fit index from eCognition and cluster size to recode instances of pasture hay to herbaceous. Rectangular fit index looks at the shape of the cluster in order to identify those with convoluted shapes, which would indicate herbaceous areas, rather then pasture hay. Manual inspection of spectral properties was used to determine an appropriate threshold of both rectangular fit and cluster size. Final inspection of the imagery by an analyst indicated that the clusters were more likely to correspond to herbaceous versus pasture/hay.

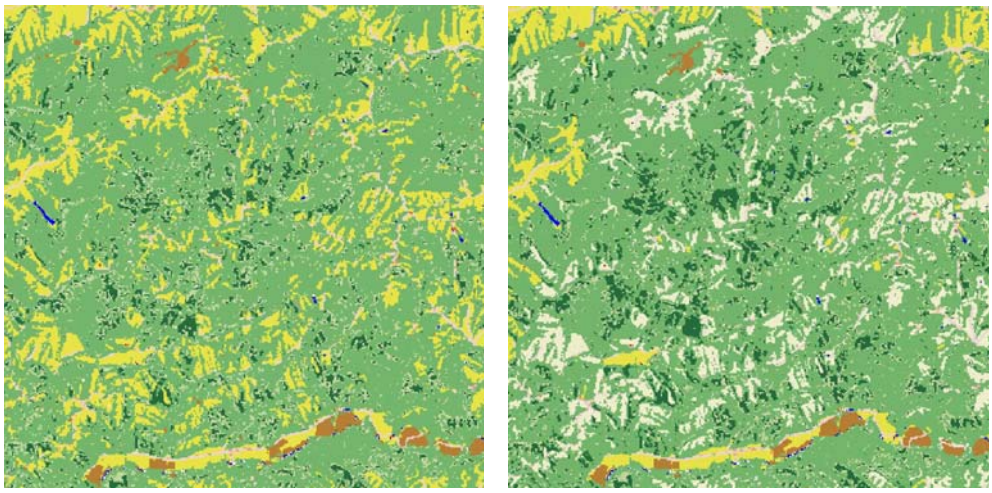


Figure 21: Area showing abundant pasture/hay class.
Figure 22: Pasture/hay reclassed to herbaceous based on shape and size.

5.11 Scattered Cropland Pixels

Throughout the landcover classification, reviewers found cropland clumps that were misclassified. To solve this problem, a majority filter was run on any cropland clump less then 10 pixels. This recoded the clumps to the most likely class. Manual editing methods ensured that the cropland was recoded to the most appropriate class.

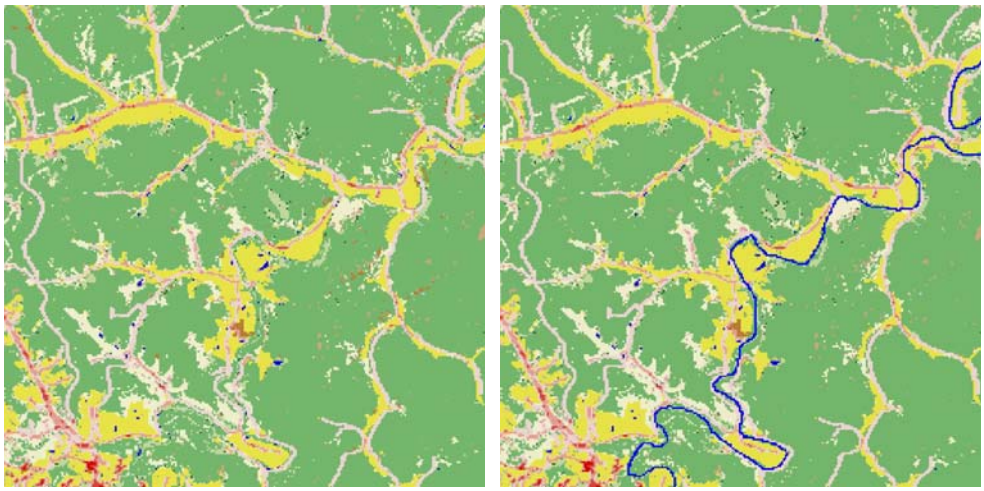


Figure 23: Scattered, incorrect cropland pixels throughout imagery.
Figure 24: Small clumps of cropland classes changed to majority landcover type.

5.12 Other Localized Errors

The reviewers and Space Imaging Analysts both found areas of inclusion or exclusion areas that needed to be corrected. Any misclassifications pointed out were corrected with the use of supporting imagery and ancillary data. One example of this was in an area where impervious structures were labeled as pasture/hay. These issues were identified and rectified using manual editing techniques.

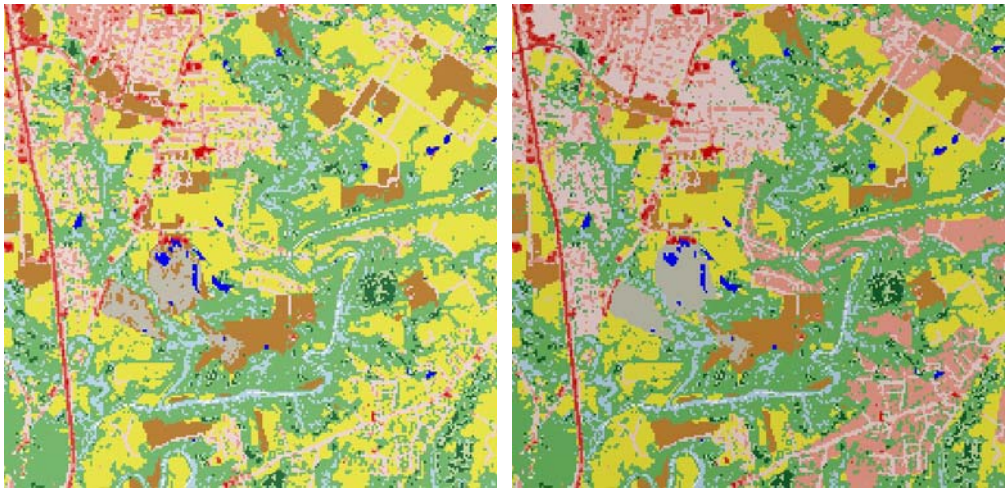


Figure 25: Urban areas incorrectly classed as pasture/hay or cropland.
Figure 26: Corrected areas classed appropriately as developed low impervious.

6 Conclusions

Space Imaging has reviewed all the comments submitted by the reviewers. These comments were compiled into a table and each issue was addressed. The resulting map landcover map shows an improvement of the map over the draft map, and both the EDC (USGS) and the reviewers will review the map for final accuracy.
This map will form the basis for the KLCD currently under development.